Rijksinstituut voor Volksgezondheid en Milieu
Ministerie van Volksgezondheid, Welzijn en Sport

Rathenau Instituut

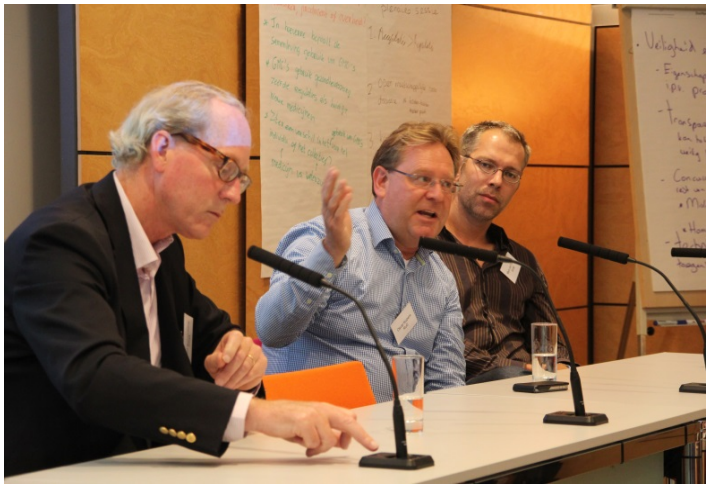
Report on debate 'Responsible approach to synthetic biology'

On 17 September 2014, RIVM and the Rathenau Institute organized a meeting for policymakers on the subject of synthetic biology. What does this technology actually involve and how is it used? What are its prospects and opportunities and how cautious should we be in implementing them? Experts described the rise of synthetic biology. Teams of students from the international genetically engineered machine [iGEM] competition also demonstrated how their projects were effected using this technology.

Synthetic biology is a technoscientific development whereby technical design principles are applied at a molecular biology level. Currently this technique is developing rapidly, is being widely applied and is expected to have a great economic impact. According to André van der Zande, Director-General of RIVM, synthetic biology is mainly a promise for the future: "This is why it is important to get involved at an early stage, and not to adopt a rigid point of view that cannot be changed at a later time."

Consequences for people and society

The arrival of this new technology has numerous consequences for people and society. It provides opportunities for new ways of producing biofuels, medicines, artificial odours and flavourings, as well as raw materials for the chemical industry. New forms of antibiotics are also being developed in this way. Yet other developments are focused on biosensors that can be used to detect decay in foodstuffs or specific types of environmental pollution.



But what is it exactly? To give a clearer idea of this, Mark van Passel of RIVM explained how synthetic biology has developed over recent years: "It is a form of approach, not a tool or an aim." It encompasses engineering, the building of switches, metabolic routes or organisms that do not occur in nature. To paraphrase Drew Endy the American guru in this field, because we make them ourselves we understand them better. And this makes them more predictable.

One example of synthetic biology is the engineering of production routes that are optimised to meet our own needs. They are standardised and abstracted reconstructions. Thus this technology goes a step further than genetic modification in which often only a single piece of DNA is involved. Van Passel: "An example of synthetic biology could be a light switch that can be turned on and off at will and is constructed of a number of pieces of DNA."

New antibiotics
How can we use them? There are promising new applications in which medicines can be transported to specific areas of the body to deliver their active substances there. In this way, the medicine is much more effective and there are fewer side effects. This is a promising way of treating cancer, and another particularly appealing application is the production of antibiotics.

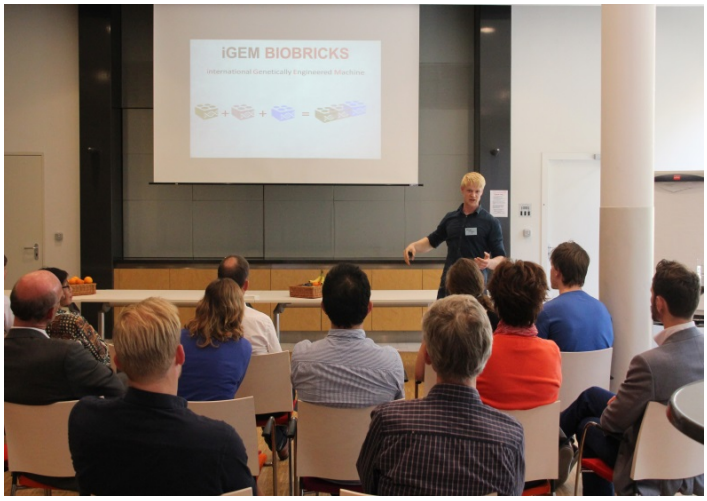
Professor Oscar Kuipers of the University of Groningen explained more about this. Due to the increasingly acute problem of resistance to pathogenic bacteria it is hugely important that new antibiotics are developed. “You need to have something in reserve if a patient is carrying a bacteria that is resistant to all commonly-used antibiotics,” said Kuipers. But it is not as simple as that and furthermore it is time-consuming and expensive: synthetic biology may provide a solution, for example it has enabled the development of ‘lantibiotics’ that do not exist in nature. Lantibiotics are peptides that have an antimicrobial action. They are very effective, non-toxic and there is only a small risk that resistance to them will develop quickly. This is because these newly-developed lantibiotics are *new to nature* and thus will not be recognised by pathogenic bacteria. There are currently 3 or 4 lantibiotics under development.

Industrial applications
Roel Bovenberg from DSM was also invited to the meeting. He talked of his experiences of synthetic biology in the business sector and gave an impression of its industrial applications. As the end of the fossil fuel era approaches – even if it is temporary – he made the case for a biobased economy. Bovenberg: “We must be economical with what nature has created. Indigestible or reusable biomass can be turned into products such as fuels. The best scenario would be if the cycle wastes nothing and we were able to reduce CO2 emissions.”

For the time being diverse companies are working on component parts of the whole process that starts with the production of biomass and goes right up to the production of biofuel. In his opinion, it is necessary to have forums where companies are able to align and coordinate the individual parts and to implement the whole process. “In this way we will leave a smaller footprint, which is, of course, very desirable."

And it is possible. DSM has worked in the US on a factory trial for the production of bio-ethanol. This fuel has now been introduced commercially and the first factory for its production has opened in Italy.

Chances and opportunities
One point of concern is that technological developments are going so quickly that the systematic risk assessment process is lagging behind. How can this be regulated? And who is responsible for safe usage? The experts who develop the technology (safe by design) or the company that sells it? Or should it be the government?
The second part of the meeting covered these and other questions. During this session iGEM students presented a number of cases illustrating dilemmas which were discussed by the audience. The suggestion was made that discussion on synthetic biology applications should be differentiated as the degree of acceptance may vary depending on the product. A commonly-held point of view was that it is of great importance to emphasise the advantages of the products on comparison with the alternatives and to use attractive examples to do this.



A permanent dialogue is essential. “It is essential to take up the challenge”, said a member of the audience: “Don’t seize up – there are so many possibilities. Explain these possibilities in plain language. Use metaphors or analogies and don’t say it is too complex or it cannot be explained. Many an expert has made that mistake.”

It was in this atmosphere that Jan Staman, Director of the Rathenau Institute closed the meeting. “This discussion is not about the knowledge but about fear.” The underlying feeling determines the discussion; to quote the philosopher David Hume: *reason is the slave of the passions*. He emphasised that we need to make contact with those involved, i.e. the public. The prevailing opinion makes huge demands on the way in which we interact with the public. “If we go about this properly something very good could develop from it. Ultimately, the aim of all knowledge is surely to make the world a better place.”